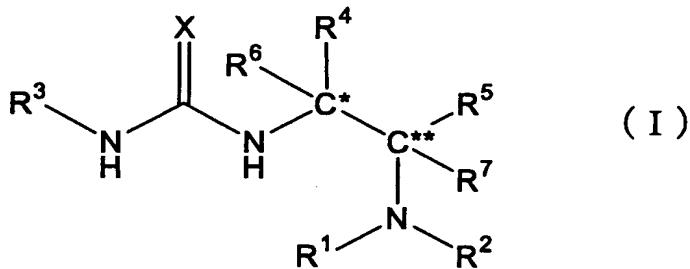


### Claims

1. A compound represented by the formula (I):



wherein

- 5    X is an oxygen atom or a sulfur atom;  
C\* and C\*\* are each independently an asymmetric carbon;  
R<sup>1</sup> and R<sup>2</sup> are  
the same or different and each is a lower alkyl group  
optionally having substituent(s), an aralkyl group  
10    optionally having substituent(s) or an aryl group  
optionally having substituent(s), or R<sup>1</sup> and R<sup>2</sup> optionally  
form, together with the nitrogen atom they are bonded to,  
an aliphatic heterocycle optionally having substituent(s)  
15    (the aliphatic heterocycle is optionally condensed with an  
aromatic hydrocarbon);

R<sup>3</sup> is

- a lower alkyl group optionally having substituent(s), an  
aralkyl group optionally having substituent(s), an aryl  
group optionally having substituent(s) or a heteroaryl  
20    group optionally having substituent(s);

R<sup>4</sup> and R<sup>5</sup> are

- the same or different and each is a lower alkyl group  
optionally having substituent(s), an aralkyl group  
optionally having substituent(s) or an aryl group  
25    optionally having substituent(s), or R<sup>4</sup> and R<sup>5</sup> optionally  
form, together with the asymmetric carbons they are  
respectively bonded to, a homocyclic ring optionally  
having substituent(s) or a heterocycle optionally having  
substituent(s); and

R<sup>6</sup> and R<sup>7</sup> are

the same or different and each is a hydrogen atom or a lower alkyl group optionally having substituent(s), or a salt thereof.

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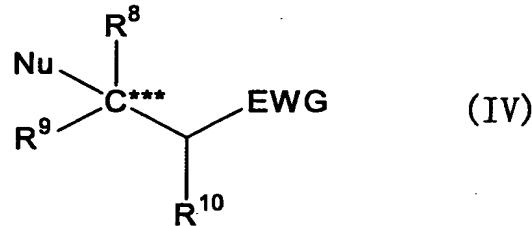
2. The compound of claim 1, wherein X is a sulfur atom, or a salt thereof.

10 3. The compound of claim 1 or 2, wherein R<sup>4</sup> and R<sup>5</sup> form, together with the asymmetric carbons they are respectively bonded to, cyclopropane, cyclobutane, cyclopentane or cyclohexane, or a salt thereof.

15 4. The compound of claim 3, wherein R<sup>4</sup> and R<sup>5</sup> form cyclohexane together with the asymmetric carbons they are respectively bonded to, and R<sup>6</sup> and R<sup>7</sup> are each a hydrogen atom, or a salt thereof.

20 5. The compound of claim 4, wherein the absolute configurations of C\* and C\*\* are both S-configurations or both R-configurations, or a salt thereof.

6. A method of producing a compound represented by the formula (IV):



25

wherein

C\*\*\* is an asymmetric carbon;

R<sup>8</sup>, R<sup>9</sup> and R<sup>10</sup> are

30 the same or different and each is a hydrogen atom, a lower alkyl group optionally having substituent(s), an aralkyl

group optionally having substituent(s), an aryl group  
optionally having substituent(s), a heteroaryl group  
optionally having substituent(s), a hetero atom optionally  
having substituent(s) or an electron withdrawing group, or  
5 R<sup>9</sup> and R<sup>10</sup> optionally form, together with the carbon atoms  
they are respectively bonded to, a homocyclic ring  
optionally having substituent(s) or a heterocycle  
optionally having substituent(s), provided that R<sup>8</sup> and R<sup>9</sup>  
are not the same groups;

10 EWG is

an electron withdrawing group selected from a nitro group,  
a cyano group, -COR<sup>11</sup>, -SO<sub>2</sub>R<sup>12</sup>, -COOR<sup>13</sup> and -PO(OR<sup>14</sup>)(OR<sup>15</sup>)  
wherein

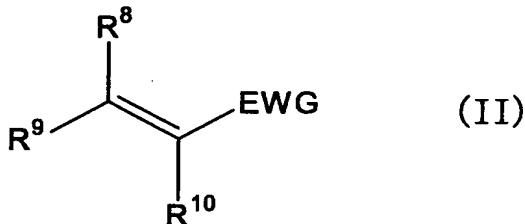
15 R<sup>11</sup>, R<sup>12</sup>, R<sup>13</sup>, R<sup>14</sup> and R<sup>15</sup> are the same or different and  
each is a hydrogen atom, a lower alkyl group  
optionally having substituent(s), an aralkyl group  
optionally having substituent(s), an aryl group  
optionally having substituent(s) or a heteroaryl group  
optionally having substituent(s), or R<sup>11</sup> and R<sup>8</sup>, or R<sup>11</sup>  
20 and R<sup>10</sup>, optionally form, together with the carbon  
atom(s) they are respectively bonded to, a homocyclic  
ring having an electron withdrawing group and  
optionally having substituent(s); and

Nu is

25 -CR<sup>16</sup>(COR<sup>17</sup>)(COR<sup>18</sup>), -OR<sup>19</sup>, -SR<sup>20</sup>, -NR<sup>21</sup>R<sup>22</sup>, -C(NO<sub>2</sub>)R<sup>23</sup>R<sup>24</sup>  
wherein

30 R<sup>16</sup> is a hydrogen atom, a halogen atom, a hetero atom  
having substituent(s), a lower alkyl group optionally  
having substituent(s) or an aryl group optionally  
having substituent(s);  
R<sup>17</sup> and R<sup>18</sup> are the same or different and each is a  
hydrogen atom, a lower alkyl group, a lower alkoxy  
group, a mono-lower alkylamino group or a di-lower  
alkylamino group;

R<sup>16</sup> and R<sup>17</sup> optionally form, together with the carbon atoms they are respectively bonded to, a homocyclic ring optionally having substituent(s) or a heterocycle optionally having substituent(s) (the homocyclic ring and heterocycle are optionally condensed with an aromatic hydrocarbon); and  
 5 R<sup>19</sup>, R<sup>20</sup>, R<sup>21</sup>, R<sup>22</sup>, R<sup>23</sup> and R<sup>24</sup> are the same or different and each is a hydrogen atom, a lower alkyl group optionally having substituent(s), an aralkyl group  
 10 optionally having substituent(s), an aryl group optionally having substituent(s) or a heteroaryl group optionally having substituent(s), or R<sup>21</sup> and R<sup>22</sup> optionally form, together with the nitrogen atom they  
 15 are bonded to, an aliphatic heterocycle optionally having substituent(s), or  
 an azido group,  
 or a salt thereof, which comprises conjugately adding a nucleophilic reagent represented by the formula (III): H-Nu  
 (III) wherein Nu is as defined above, to a compound represented  
 20 by the formula (II):



wherein each symbol is as defined above, or a salt thereof, in the presence of a compound or a salt thereof of any of claims 1 to 5.  
 25

7. The method of claim 6, wherein Nu is -CR<sup>16</sup>(COR<sup>17</sup>)(COR<sup>18</sup>), -OR<sup>19</sup>, -SR<sup>20</sup>, -NR<sup>21</sup>R<sup>22</sup>, -C(NO<sub>2</sub>)R<sup>23</sup>R<sup>24</sup>

wherein

R<sup>16</sup> is a hydrogen atom, a halogen atom, a lower alkyl group  
 30 optionally having substituent(s) or an aryl group

optionally having substituent(s);

R<sup>17</sup> and R<sup>18</sup> are the same or different and each is a hydrogen atom, a lower alkyl group, a lower alkoxy group, a mono-lower alkylamino group or a di-lower alkylamino group;

5 R<sup>19</sup>, R<sup>20</sup>, R<sup>21</sup>, R<sup>22</sup>, R<sup>23</sup> and R<sup>24</sup> are the same or different and each is a hydrogen atom, a lower alkyl group optionally having substituent(s), an aralkyl group optionally having substituent(s), an aryl group optionally having substituent(s) or a heteroaryl group optionally having substituent(s), or R<sup>21</sup> and R<sup>22</sup> optionally form, together with the nitrogen atom they are bonded to, an aliphatic 10 heterocycle optionally having substituent(s), or an azido group.

15 8. The method of claim 6 or 7, wherein the electron withdrawing group for EWG is a nitro group.

9. The method of any of claims 6 to 8, wherein R<sup>8</sup> and R<sup>10</sup> are each a hydrogen atom, and R<sup>9</sup> is a lower alkyl group optionally 20 having substituent(s), an aryl group optionally having substituent(s) or a heteroaryl group optionally having substituent(s).

10. The method of any of claims 6 to 9, wherein the 25 nucleophilic reagent (III) is represented by HCR<sup>16</sup>(COR<sup>17</sup>)(COR<sup>18</sup>) wherein each symbol is as defined above.

11. The method of claim 10, wherein R<sup>16</sup> is a hydrogen atom, a lower alkyl group optionally having substituent(s), a halogen 30 atom or a hetero atom having substituent(s), and R<sup>17</sup> and R<sup>18</sup> are the same or different and each is a lower alkoxy group.

12. The method of claim 11, wherein R<sup>16</sup> is a hydrogen atom, methyl, a chlorine atom, methoxy or tert-butoxycarbonylamino,

and R<sup>17</sup> and R<sup>18</sup> are each methoxy or ethoxy.

13. The method of claim 10, wherein R<sup>16</sup> and R<sup>17</sup> optionally form, together with the carbon atoms they are respectively bonded to, a homocyclic ring optionally having substituent(s) (the homocyclic ring is optionally condensed with an aromatic hydrocarbon).

14. The method of claim 13, wherein the homocyclic ring is 1,2,3,4-tetrahydronaphthalen-1-one.

15. The method of any of claims 6 to 14, which is performed in at least one solvent selected from toluene and methylene chloride.

15

16. The method of any of claims 6 to 14, which is performed without a solvent.